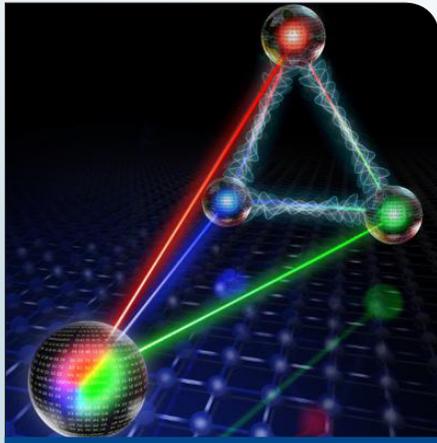


[Advanced materials \(9\)](#)[Autonomous systems & robotics \(1\)](#)[Communications technology \(2\)](#)[Cyber security \(1\)](#)[Energy \(2\)](#)[Forecasting \(1\)](#)[Information technology \(2\)](#)[Materials science \(5\)](#)[Microelectronics \(3\)](#)[Photonics \(1\)](#)[Quantum science \(3\)](#)[S&T policy \(1\)](#)[Science without borders \(1\)](#)[Sensors \(2\)](#)

## FEATURE ARTICLES

### [Extending Einstein's spooky action for use in quantum networks](#)

[PhysOrg.com](#), 15JAN2015



*Credit: Phys.org*

paving the way for exploration of larger quantum networks. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Featured Article*

### [Video series explores the state and future of technological convergence](#)

[Brightsurf](#), 15JAN2015

In a new series of videos, leading scientists from across the United States discuss the idea of convergence and how it affects their work. It is part of the international study, "Societal Convergence for Human Progress," sponsored by NSF, NIH, NASA, EPA, DOD and USDA. Final report [Convergence of Knowledge, Technology, and Society: Beyond Convergence of Nano-Bio-Info-Cognitive Technologies](#)

*Tags: Forecasting, Emerging technology, Featured Article*

## ADVANCED MATERIALS

### [A contractile gel that stores light energy](#)

[Science Daily](#), 20JAN2015

Researchers in France have made a polymer gel that is able to contract through the action of artificial molecular motors. When activated by light, these nanoscale motors twist the polymer chains in the gel, which as a result contracts by several centimeters. Just as in living systems, the motors consume energy in order to produce continuous motion. However, this light energy is not totally dissipated: it is turned into mechanical energy through the twisting of the polymer chains, and stored in the gel. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T France*

### [Laser-generated surface structures create extremely water-repellent metals](#)

[PhysOrg.com](#), 20JAN2015

Researchers at the University of Rochester have used extremely powerful, but ultra-short, laser pulses to transform metals into super-hydrophobic materials without the need for temporary coatings. The new material is much more slippery than Teflon. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

### [Researchers develop cheaper and simpler radar-absorbent material](#)

[PhysOrg.com](#), 20JAN2015

The frequency selective surface absorber developed by researchers in Ireland absorbs a wide range of frequencies over a wide range of incident angles, regardless of polarisation, and it is only 3 mm thick. This thickness is around one tenth the wavelength of the radar radiation to be absorbed and much thinner than more traditional planar RAM, but the material still achieves 90% backscatter suppression at incident angles up to 45°. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## S&T NEWS ARTICLES

**Graphene multiplies the power of light**

Nanowerk, 19JAN2015

Using a cutting-edge spectroscopic method, an international team of researchers (Switzerland, Denmark, Italy, UK, Germany) has demonstrated that by absorbing a single photon, graphene can generate multiple electrons that have enough energy to drive an electrical current. Novel photovoltaic devices using graphene could harvest light energy across the entire solar spectrum with lower energy loss than current systems. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Photonics*

**Topological protection in mechanical metamaterials**

PhysOrg.com, 19JAN2015

Researchers in the Netherlands showed that certain crystal defects in mechanical metamaterials can harbour topologically protected motions. These mechanical states are analogues of protected electronic states in quantum materials such as topological insulators. When actuated, such protected mechanisms could serve as the building blocks of robots. The research paves the way towards engineering nano-mechanical structures for robust information storage and read-out. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

**Breakthrough lights up metamaterials**

Science Daily, 16JAN2015

An international team of researchers (USA, Canada) led by the City College of New York has demonstrated how to enhance light emission and capture light from metamaterials embedded with light emitting nanocrystals. They used metamaterials having hyperbolic dispersion to enhance the light emission properties of the nanocrystals and simultaneously engineered an efficient light extraction scheme. The discovery could lead to nanoscale lasers and efficient single photon sources. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

**Laser-induced graphene 'super' for electronics**

Technology Org, 15JAN2015

Researchers at Rice University advanced their recent development of laser-induced graphene (LIG) by producing and testing stacked, three-dimensional supercapacitors, that are important for portable, flexible electronics. The flexible stacks show excellent energy-storage capacity and power potential and can be scaled up for commercial applications. LIG can be made in air at ambient temperature, perhaps in industrial quantities through roll-to-roll processes. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

**Two-dimensional metamaterial surface manipulates light**

Science Magazine, 14JAN2015

Researchers at Pennsylvania State University have designed, fabricated and tested a single layer of metallic nanostructure that can provide exceptional capabilities for manipulating light. This engineered surface, which consists of a periodic array of strongly coupled nanorod resonators, could improve systems that perform optical characterization in scientific devices, sensing, or satellite communications. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

**Black Phosphorus: The Birth of a New Wonder Material**

MIT Technology Review, 12JAN2015

An international team of researchers (Ireland, UK, China) has perfected a way of making large quantities of black phosphorus nanosheets with dimensions they can control. They have used this new found ability to test black phosphorus in a number of new applications, such as a gas sensor, an optical switch, and even to reinforce composite materials to make them stronger. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

**AUTONOMOUS SYSTEMS & ROBOTICS****Video Friday: Humanoids Sing, Giant Eyeball Robot, and Kuka Ping Pong Revenge**

IEEE Spectrum, 16JAN2015

Charlie is an almost entirely 3D printed robotic insect with capabilities similar to UC Berkeley's STAR robot. Charlie takes about 24 hours to print and is controlled via Bluetooth from your phone.

Tags: *Autonomous systems & robotics*

**COMMUNICATIONS TECHNOLOGY****Many antennas, multiple benefits: Can handle cellular traffic more reliably**

Science Daily, 20JAN2015

Researchers in Singapore sought to combine large-scale multiple-input multiple-output (L-MIMO) and distributed-antenna systems (DAS) into a novel type of antenna system. The team's strategy, known as large-scale distributed-antenna systems (L-DAS), seeks to implement DAS with a massive installation base, as seen with MIMO antennas. This new architecture for wireless communications can help meet growing demands for increased network capacity and improved energy efficiency. [TECHNICAL ARTICLE](#)

Tags: *Communications Technology*

“Research is to see what everybody else has seen, and to think what nobody else has thought.” ALBERT SZENT-GYÖRGI

### **New signal amplification process set to transform communications, imaging, computing**

PhysOrg.com, 20JAN2015

Designed by researchers and UC San Diego, the key discovery and innovation for the amplification process is to use the compensating impurities as the intermediate steps for electron-hole pair generation. Impurity states are localized, so the conservation of momentum that limits the efficiency for conventional impact ionization can be greatly relaxed and leads to higher signal amplification efficiency and reduced operation voltage. [TECHNICAL ARTICLE](#)

Tags: *Communications Technology*

## CYBER SECURITY

### **New Report Says No Technological Replacement Exists for Bulk Data Collection**

National Research Council, 15JAN2015

No software-based technique can fully replace the bulk collection of signals intelligence, but methods can be developed to more effectively conduct targeted collection and to control the usage of collected data, says a new report from the National Research Council.

Tags: *Cyber security*

## ENERGY

### **Research aims to improve lithium-based batteries**

Nanowerk, 20JAN2015

Researchers at Purdue University show how groups of dendrites form and evolve and how individual dendrites interact with each other. The simulations also depict how dendrites sometimes detach from battery electrodes and become floating deposits, another potentially dangerous scenario that can cause a battery to catch on fire.

[TECHNICAL ARTICLE](#)

Tags: *Energy, Battery, Materials science*

### **Perovskites provide big boost to silicon solar cells**

Science Daily, 15JAN2015

An international team of researchers (USA, Switzerland) led by Stanford University reports that stacking perovskites onto a conventional silicon solar cell dramatically improves the overall efficiency of the cell. They used a sheet of plastic with silver nanowires to overcome the lack

of transparency. They improved the 11.4 percent silicon cell to 17 percent tandem. A key roadblock to building an efficient perovskite-silicon tandem has been a lack of transparency. [TECHNICAL ARTICLE](#)

Tags: *Energy, Advanced materials, Solar energy*

## INFORMATION TECHNOLOGY

### **Optimizing optimization algorithms**

MIT News, 21JAN2015

One way to solve a difficult optimization problem is to first reduce it to a related but much simpler problem, then gradually add complexity back in, solving each new problem in turn and using its solution as a guide to solving the next one. This approach seems to work well in practice, but it's never been characterized theoretically. Researchers at MIT describe a way to generate that sequence of simplified functions that guarantees the best approximation that the method can offer. [TECHNICAL ARTICLE](#)

Tags: *Information Technology, Mathematics*

### **Software that knows the risks**

Science Daily, 16JAN2015

Researchers at MIT have developed software that allows a planner to specify constraints and reliability thresholds. On the basis of probabilistic models the system determines whether a solution exists. If, however, a solution doesn't exist it suggests ways in which the planner might relax the problem constraints. The algorithm would be just as useful for any planning task—say, scheduling flights or bus routes. One aspect of the software that distinguishes it from previous planning systems is that it assesses risk. [TECHNICAL ARTICLE](#)

Tags: *Information Technology*

## MATERIALS SCIENCE

### **Self-assembled nanotextures create antireflective surface on silicon solar cells**

Science Daily, 21JAN2015

Reducing the amount of sunlight that bounces off the surface of solar cells helps maximize the conversion of the sun's rays to electricity. Researchers at DOE's Brookhaven National Laboratory show that etching a nanoscale texture onto the silicon material itself creates an antireflective surface that works as well as state-of-the-art thin-film multilayer coatings.

Tags: *Materials science, Energy, Government S&T, Solar energy*

**Mathematical approach provides a new step in resolving the mystery of glass**

PhysOrg.com, 19JAN2015

Glasses have an irregular structure that leads to a situation where the ground state of glasses is achieved by a multitude of configurations of their constituent particles. Researchers at Pennsylvania State University set out to find a simple approach that would reduce the computational complexity allowing them to approximate the ground state of glassy systems.

*Tags: Materials science*

**Self-destructive effects of magnetically-doped ferromagnetic topological insulators**

Science Daily, 19JAN2015

An international team of researchers (USA, South Korea, China, Scotland) discovered that the Dirac mass is extremely disordered at the nanoscale, which was completely unanticipated. In ferromagnetic topological insulators, the chaos eventually destroys the exotic surface state. The findings explain why many of the electronic phenomena expected to be present in ferromagnetic topological insulators are in fact suppressed by the very atoms that generate this state. This new understanding will likely result in revisions of the basic research directions in this field. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

**FEATURED RESOURCE****MIT Technology Review**

Identifies emerging technologies and analyzes their impact for leaders, R&D sponsors, developers, and researchers in government, academia, industry and business. [RSS](#)

**Solving an organic semiconductor mystery**

Science Daily, 15JAN2015

A team of researchers in the USA (DOE's Lawrence Berkeley Laboratory, UC Berkeley) discovered a cluttered jumble of randomly oriented nanocrystallites that become kinetically trapped in the interfaces during solution casting. Like debris on a highway, these nanocrystallites impede the flow of charge-carriers. The discovery should add a predictive factor to scalable and affordable solution-processing and help minimize discontinuities and maximize charge-carrier mobility. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Government S&T, Microelectronics*

**Water-soluble silicon leads to dissolvable electronics**

PhysOrg.com, 15JAN2015

A team of US researchers (University of Illinois at Urbana-Champaign, MIT Lincoln Laboratory, Tufts University) is developing water-soluble integrated circuits that dissolve in water or biofluids in months, weeks, or even a few days. This technology, called transient electronics, could have applications for biomedical implants, zero-waste sensors, and many other semiconductor devices. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Microelectronics*

**MICROELECTRONICS****Photometallization allows production of the entire circuitry on touchscreens in one step**

PhysOrg.com, 20JAN2015

Researchers in Germany are basing the novel process on photometallization: under exposure to UV light, and acting in conjunction with a photoactive layer, colourless silver compounds turn into electrically conductive silver. The silver compound can be applied in the form of tracks or other structures to plastic films or glass by various methods. Tracks of various sizes, down to the smallest size of a 1000th of a millimetre, can be created in this way. The corresponding conductor tracks are then produced by exposure to UV light.

*Tags: Microelectronics, S&T Germany*

**New laser for computer chips: International team of scientists construct first germanium-tin semiconductor laser for silicon chips**

Science Daily, 19JAN2015

An international team of researchers (Germany, Switzerland, UK, France, Spain) describes the first semiconductor consisting solely of elements of main group IV. The germanium-tin (GeSn) laser can be applied directly onto a silicon chip and thus create a new basis for transmitting data on computer chips via light: this transfer is faster than is possible with copper wires and requires only a fraction of the energy. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Advanced materials*

**Nanowire photonic chip detects single photons**  
Nanotechweb, 16JAN2015

A team of researchers in the US (MIT, IBM, JPL) has built an array of light detectors on a photonic chip that can efficiently record single photons. Such devices will be essential elements of future quantum technologies, such as quantum cryptography and optical quantum computers. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Photonics, Quantum science*

## PHOTONICS

**Race of the electrons: Laser pulses can be used to track the motion of electrons in metals with attosecond precision**[Science Daily, 14JAN2015](#)

Researchers in Austria report that two different metals—tungsten and magnesium—are stacked and hit with a laser pulse. Either in the magnesium or in the tungsten layer, the light can remove electrons, which then find their way to the surface. The distance the electrons have to cover is less than a nanometer, but still it is possible to quantify the lead of the electrons from the magnesium layer, arriving shortly before the electrons from the tungsten layer. The new findings are expected to help with the miniaturization of electronic and photonic elements. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Particle physics*

## QUANTUM SCIENCE

**Atoms can be in two places at the same time**  
[PhysOrg.com, 20JAN2015](#)

An international team of researchers (Germany, UK) grabbed a single Caesium atom with two optical tweezers and pulled it in two opposing directions. In the macro-realist's world the atom would then be at only one of the two final locations. Quantum-mechanically, the atom would instead occupy a superposition of the two positions. They used indirect measurements to determine the final position of the atom in the most gentle way possible. The experimental findings fit well with an interpretation based on superposition states that get destroyed when the indirect measurement occurs. All that we can do is to accept that the atom has indeed taken different paths at the same time. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, S&T Germany***Efficient error estimation in quantum key distribution**[IOP Science, 18JAN2015](#)

An international team of researchers (China, Thailand) proposes an efficient error estimation scheme for QKD, which is called parity comparison method (PCM). In the proposed method, the parity of a group of sifted keys is practically analysed to estimate the quantum bit error rate instead of using the traditional key sampling. From the simulation results, the proposed method improves the accuracy and decreases revealed information in most realistic application situations.

*Tags: Quantum science, S&T China*

## S&amp;T POLICY

**European Commission reveals details of proposed cuts to science**[Science Magazine, 15JAN2015](#)

A controversial plan to use research funds to pay for economic stimulus became more concrete this week. The new investment fund would take €2.7 billion over 5.5 years from Horizon 2020, the commission's main funding stream for research that will invest about €80 billion between 2014 and 2020. [Draft legislation](#), released on 13 January, lays out the framework for the stimulus.

*Tags: S&T policy, S&T EU*

## SCIENCE WITHOUT BORDERS

**Extremely short, sharp flash of radio waves from unknown source in the universe, caught as it was happening**[Science Daily, 19JAN2015](#)

Using a technique developed in Australia, researchers in Denmark have succeeded in observing the first 'live' burst with the Parkes telescope. The characteristics of the event indicated that the source of the burst was up to 5.5 billion light years from Earth. The signal from the radio wave burst was more than 20 percent circularly polarised and it suggests that there is a magnetic field in the vicinity.

[TECHNICAL ARTICLE](#)*Tags: Science without borders, Astronomy*

## SENSORS

**Novel pressure and displacement sensors based on carbon nanotubes**[IOP Science, 18JAN2015](#)

An international team of researchers (Pakistan, Tajikistan, Malaysia) describes newly designed pressure and displacement capacitive sensors based on a flexible paper-CNT structure. The CNT powder was deposited on a thin paper substrate and was pressed at an elevated temperature. The sensitivities of the pressure and the displacement sensors were found to be 17.3 pF/cm<sup>2</sup>/kN and 0.93 10<sup>-3</sup> pF/μm, respectively.

The experimental results and simulated data were in agreement with each other.

*Tags: Sensors, CNT*

## Research team invents new chemical detector

PhysOrg.com, 15JAN2015

Researchers at the University of Delaware have invented the Quantitative Carbon Detector (QCD), a new device that identifies and quantifies chemical compounds in complex mixtures such as fuels, oils, chemicals, pharmaceuticals and food. This instrument will have a significant impact on the amount of time required for chemical analysis.

*Tags: Sensors* ■

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